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MINISTRY OF TECHNOLOGY

EXPLOSIVES RESEARCH AND DEVELOPMENT ESTABLISHMENT

TECHNICAL REPORT No. 29

The Effect of Explosives and Propellants on some Thermoplastics and Rubbers Part 3

B E Brokenbrow
D Sims
A L Stokoe

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The Effect of Explosives and Propellants on some Thermoplastics and Rubbers Part 3

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SUMMARY

Three rubber vulcanisates, chlorobutyl, natural, and butadiene, two thermoelastomers, plasticised PVC, and six thermoplastics, polystyrene, nylon 6 and 66, high and low density polyethylene, and polymethylmethacrylate have been exposed to the explosive TNT and propellant NQ for intervals of up to twelve months. All the rubbers are affected by both TNT and propellant NQ, whereas of the plastics only polymethylmethacrylate is seriously affected.

Further copies of this technical report can be obtained from Ministry of Technology Reports Centre, Station Square House, St Mary Cray, Orpington, Kent. BR5 3RE

CONTENTS

Reference: WAC/207/011

1 INTRODUCTION

A review of previous published work[1] on the effects of TNT and propellant NQ on rubbers and plastics had shown several omissions concerning common polymeric materials. To fill in some of these gaps in knowledge a further range of materials have been exposed to the effects of TNT and propellant NQ.

2 MATERIALS

The composition of the three rubber vulcanisates and the conditions of cure are listed in Appendix A. The two thermoelastomers were both block copolymers of butadiene and styrene which are rubbery at room temperature but are processed as thermoplastics. The thermoplastics used were:

GP polystyrene (Lustrex GP Monsanto Ltd)

nylon 6 (F194 ICI Ltd)

nylon 66 (A190 ICI Ltd)

high density polyethylene (Rigidex R101 BP Chemicals Ltd)

low density polyethylene (Alkathene WG47 ICI Ltd)

polymethylmethacrylate (Diakon MO ICI Ltd)

thermoelastomer A (Cariflex TR 226 Shell Chemicals UK Ltd)

" B (Cariflex TR 201 Shell Chemicals UK Ltd)

The composition of plasticised PVC was as given in Appendix A.

The explosives and propellant used were TNT Grade A to Specification CS 5023 and Cordite NQ to Specification P323 containing

nitroglycerine	20.6 per cent
nitrocellulose	20.8 per cent
nitroguanidine	55.0 per cent
carbamite	3.6 per cent
cryolite	0.3 per cent

3 EXPERIMENTAL

The thermoplastics were injection moulded on a screw injection machine into an eight cavity mould to a small dumb-bell design previously described.[3] The rubbers and plasticised PVC were cut to give E-type dumb-bells. Dumb-bells of each material were conditioned, before exposure and initial testing, by storing in an uncharged desiccator for 48 hours at room temperature.

Testing and exposure were generally as described in previous reports.[1,2]

Withdrawals were made at one, three, six, nine and twelve months and a set of control specimens was also tested at each withdrawal.

4 RESULTS AND DISCUSSION

The results for the rubbers are given in Tables 1 and 2 and for thermoplastics in Tables 3 and 4. The visual assessment of the materials is given in Table 5.

4.1 Chlorobutyl Rubber

This material shows some changes in the control specimens stored at 60°C. The changes are mainly a softening and an initial increase in elongation at break. In contact with TNT a slow increase in weight occurred accompanied by a fall in the ultimate tensile strength of the material. After twelve months' exposure to TNT the tensile strength had decreased by about 25 per cent. With propellant NQ however a rapid fall off in properties occurs with the ultimate tensile strength falling by 75 per cent, the elongation at break by 25 per cent and the hardness decreasing considerably.

4.2 Natural Rubber

This material showed marked degradation under control conditions and the tensile strength fell to 27 per cent of its initial value after twelve months. Contact with TNT resulted in no obvious increase in degradation, although there was a 12 per cent increase in weight. Contact with NQ however did markedly increase the rate of deterioration, the rubber also becoming very brittle after only three months.

4.3 Butadiene Rubber

The control specimens aged much better than the natural rubber mix and after an initial fall in properties showed only slow changes. In contrast to natural rubber, contact with TNT resulted in an increase in tensile strength and a fall in elongation at break indicating considerable chemical change. Contact with NQ also produced an increase in tensile strength combined with a very rapid fall in elongation at break leading to brittle behaviour.

4.4 Thermoelastic Rubbers

Both of these materials showed better heat ageing characteristics under control conditions than those materials previously tested.[2] Rubber A retained about 50 per cent ITS and rubber B 60 per cent ITS after twelve months' ageing. On exposure to TNT and NQ rubber A broke down completely after one month. Rubber B was more resistant but became very weak in the presence of TNT and embrittled in contact with NQ.

4.5 Plasticised PVC

On storage the material showed little change. A small weight loss occurred, almost certainly due to loss of plasticiser. On contact with NQ little change in physical properties occurred although a weight gain of 4 per cent was recorded. In contact with TNT the material changed colour significantly becoming dark brown and a gain in weight of 16 per cent occurred. However little change in mechanical properties was observed.

4.6 Polystyrene

Polystyrene samples were unaffected both as controls and as exposed specimens.

4.7 Nylon 6

This material again showed loss of elongation, increased tensile strength and slight weight loss under control conditions similar to nylon 66. Contact with TNT and NQ resulted in little additional change.

4.8 Nylon 66

Nylon 66 showed some changes when stored under control conditions. The tensile strength increased and the elongation at break decreased. This was accompanied by a slight loss in weight, therefore the effects observed could to some extent be caused by the samples drying out.

Exposure to TNT caused little additional change in properties but contact with NQ resulted in the yield disappearing and the material becoming rather brittle.

4.9 Polyethylene High and Low Density

These materials showed little change either as control specimens or in contact with TNT and NQ. The increases in weight were also small ($<$ 1 per cent).

4.10 Polymethylmethacrylate

This material was unaffected by the control conditions but after exposure to TNT and NQ for one month became too encrusted to test.

....

5 CONCLUSIONS

All the rubbers were affected to some degree by contact with TNT and propellant NQ. None of them could therefore be recommended for contact with these types of explosives or propellants. Of the plastics only polymethylmethacrylate was badly affected, the remaining materials being either slightly affected or resistant to deterioration under these conditions.

6 BIBLIOGRAPHY

1	Hollingsworth B L, Ledbury K J Stokoe A L	The effect of explosives and propellants on some thermoplastics and rubbers. ERDE Report No 11/R/68
2	Brokenbrow B E, Ledbury K J, Sims D, Stokoe A L	The effect of explosives and propellants on thermoplastics and rubbers Part 2. ERDE Technical Report No 5
3	Golden J H, Hazell E	J Polymer Sci., 1963, A1, 1671

APPENDIX A

Chlorobutyl Rubber (Enjay HT-10-66)	100	-	-
Natural Rubber (SMR 5)	-	100	-
Polybutadiene (Intene 35 S)	-	-	100
Zinc Oxide	5	5	3
Stearic Acid	1	3	1.5
Carbon Black FEF	35	50	35
Process Oil (OM 13)	10	-	-
Phenyl β-Naphthylamine (BPNA)	-	1	1
Nagrina	1	-	-
Diphenylguanidine (DPG)	-	-	0.5
N-cyclohexylbenzthiazole 2-Sulphenamide (CBS)	-	-	1.0
Mercaptobenzthiazole Disulphide (MBTS)	2	1	-
Tetramethylthiuram Disulphide (TMT)	1	-	-
2,2-methylene bis-(4-methyl-6-tertiary-butylphenyl)	1	-	-
Sulphur	-	3	2
Cure time, minutes	40	40	35
Cure temperature, °C	150	144	144

Polyvinyl chloride

Polyvinyl chloride	100
Dioctyl phthalate	40
Dibutyl tin laurate	2

Mixed on a hot mill and pressed in a mould into test sheets.

Explosives and Propellants

TNT	Trinitrotoluene to Specification CS 5023
Cordite NQ	A propellant containing about 20 per cent nitroglycerine and 55 per cent nitroguanidine to Specification P 323

KEY TO TABLES 1 - 4

BS°	-	British Standard degrees
H	-	Hardness
IEB	-	Initial elongation at break (expressed as percentage, Tables 1 - 2)
IEB	-	Initial elongation at break (expressed as mm crosshead separation, Tables 3 - 4)
IEY	-	Initial elongation at yield (expressed as mm crosshead separation)
IM_{100}	-	Initial modulus at 100% elongation
IM_{300}	-	Initial modulus at 300% elongation
ITS	-	Initial tensile strength
IYS	-	Initial tensile strength at yield
% IEB	-	Percentage of initial elongation at break
% IEY	-	Percentage of initial elongation at yield
% ITS	-	Percentage of initial tensile strength
% IYS	-	Percentage of initial tensile strength at yield

TABLE 1

EFFECT OF EXPLOSIVE TNT AND PROPELLANT I

Temperature of Test 60°±0.5

Material	Exposure, months	Control						T		
		ITS MN/m² 10.2	IEB % 557	IM_{100} MN/m² 1.48	IM_{300} MN/m² 6.44	H BS° 61	Weight Change %	ITS MN/m² 10.2	IEB % 557	IM_{100} MN/m² 1.48
		% ITS	% IEB	% IM_{100}	% IM_{300}			% ITS	% IEB	% IM_{100}
Chlorobutyl	1	116	148	44	45	57	- 1.7	98	88	105
	3	102	137	36	46	56	- 0.3	90	75	144
	6	121	142	55	60	58	- 0.3	96	106	122
	9	111	135	37	51	42	- 0.2	78	111	40
	12	109	135	34	54	41	- 0.5	75	111	40
		ITS 25.2	IEB 452	IM_{100} 3.52	IM_{300} 15.4	H 68	Weight Change %	ITS 25.2	IEB 452	IM_{100} 3.52
		% ITS	% IEB	% IM_{100}	% IM_{300}			% ITS	% IEB	% IM_{100}
Natural Rubber	1	91	87	116	110	73	+ 0.1	83	85	120
	3	82	78	135	117	77	+ 1.1	63	68	109
	6	63	60	146	-	77	+ 0.6	43	48	122
	9	42	41	134	-	73	+ 1.2	30	30	147
	12	27	26	170	-	71	+ 2.6	27	26	174
		ITS 8.9	IEB 180	IM_{100} 5.13	IM_{300} -	H 81	Weight Change %	ITS 9.9	IEB 180	IM_{100} 5.13
		% ITS	% IEB	% IM_{100}	% IM_{300}			% ITS	% IEB	% IM_{100}
Polybutadiene	1	79	82	103	-	80	- 0.03	77	75	116
	3	80	70	116	-	84	- 0.03	79	43	-
	6	79	62	136	-	83	+ 0.2	75	43	-
	9	79	61	143	-	82	+ 0.4	85	31	-
	12	79	58	156	-	85	+ 0.4	101	25	-

TABLE 1

ƷIVE TNT AND PROPELLANT NQ ON RUBBERS

ɔerature of Test $60^{\circ} \pm 0.5^{\circ}C$

	TNT						NQ					
ıt ge	ITS MN/m^2 10.2	IEB % 557	IM_{100} MN/m^2 1.48	IM_{300} MN/m^2 6.44	H BS° 61	Weight Change %	ITS MN/m^2 10.2	IEB % 557	IM_{100} MN/m^2 1.48	IM_{300} MN/m^2 6.44	H BS° 61	Weight Change %
	% ITS	% IEB	% IM_{100}	% IM_{300}			% ITS	% IEB	% IM_{100}	% IM_{300}		
	98	88	105	110	60	+ 3.0	85	81	106	102	59	+ 1.7
	90	75	144	114	65	+ 4.5	66	75	99	83	52	+ 2.8
	96	106	122	93	61	+ 4.7	37	61	81	55	44	+ 3.9
	78	111	40	56	39	+ 8.1	28	65	59	41	41	+ 5.1
	75	111	40	54	41	+ 4.4	25	75	40	33	38	+ 4.5
t e	ITS 25.2	IEB 452	IM_{100} 3.52	IM_{300} 15.4	H 68	Weight Change %	ITS 25.2	IEB 452	IM_{100} 3.52	IM_{300} 15.4	H 68	Weight Change %
	% ITS	% IEB	% IM_{100}	% IM_{300}			% ITS	% IEB	% IM_{100}	% IM_{300}		
	83	85	120	107	73	+ 4.8	16	34	69	-	62	+ 6.5
	63	68	109	101	74	+ 5.1	14	9	-	-	80	+ 23.7
	43	48	122	-	70	+ 7.0	2	8	-	-	96	+ 30.6
	30	30	147	-	71	+ 11.2	3	2	-	-	100	+ 29.8
	27	26	174	-	72	+ 12.0	2	2	-	-	100	+ 28.0
t e	ITS 9.9	IEB 180	IM_{100} 5.13	IM_{300} -	H 81	Weight Change %	ITS 9.9	IEB 180	IM_{100} 5.13	IM_{300} -	H 81	Weight Change %
	% ITS	% IEB	% IM_{100}	% IM_{300}			% ITS	% IEB	% IM_{100}	% IM_{300}		
5	77	75	116	-	79	+ 4.9	78	68	122	-	82	+ 4.6
5	79	43	-	-	84	+ 6.9	54	29	-	-	88	+ 9.7
	75	43	-	-	88	+ 10.4	103	6	-	-	99	+ 24.6
	85	31	-	-	88	+ 14.1	92	7	-	-	99	+ 26.4
	101	25	-	-	93	+ 17.7	122	6	-	-	99	+ 22.3

2

TABLE 2

EFFECT OF EXPLOSIVE TNT AND PROPELLANT NQ ON THERMOEL

Temperature of Test 60°±0.5

Material	Exposure, months	Control						T		
		ITS MN/m² 4.38	IEB % 625	IM_{100} MN/m² 0.39	IM_{300} MN/m² 1.08	H BS° 42	Weight Change %	ITS MN/m² 4.38	IEB % 625	IM_{100} MN/m² 0.39
		% IBS	% IEB	% IM_{100}	% IM_{300}			% ITS	% IEB	% IM_{100}
Thermoelastic Rubber A	1	100	100	153	123	39	+ 0.5	29	74	42
	3	59	91	39	71	< 30	< 0.01			
	6	57	87	118	74	< 30	< 0.01			Too wea
	9	45	80	18	83	< 30	< 0.01			
	12	46	84	20	71	< 30	< 0.01			
		ITS 7.5	IEB 277	IM_{100} 5.27	IM_{300} -	H 86	Weight Change %	ITS 7.5	IEB 277	IM_{100} 5.27
		% IBS	% IEB	% IM_{100}	% IM_{300}			% ITS	% IEB	% IM_{100}
Thermoelastic Rubber B	1	84	66	99	-	84	0.05	58	44	80
	3	79	45	102	-	86	0.07	53	27	-
	6	76	40	101	-	86	0.04	39	19	-
	9	68	32	-	-	84	0.02	38	20	-
	12	60	23	-	-	87	0.02	38	18	-
		ITS 17.6	IEB 250	IM_{100} 12.1		H 87	Weight Change %	ITS 17.6	IEB 250	IM_{100} 12.1
		% IBS	% IEB	% IM_{100}				% IBS	% IEB	% IM_{100}
Polyvinyl Chloride (PVC) plasticised	1	118	106	141		95	- 0.06	122	116	130
	3	123	116	142		93	- 0.16	110	108	113
	6	124	108	152		97	- 0.70	108	93	119
	9	124	114	152		92	- 0.70	107	88	120
	12	118	89	151		95	- 0.90	119	109	130

TABLE 2

ANT NQ ON THERMOELASTOMERS AND PLASTICISED PVC

re of Test $60^{o} \pm 0.5^{o}C$

TNT						NQ					
ITS /m² .38	IEB % 625	IM_{100} MN/m² 0.39	IM_{300} MN/m² 1.08	H BS° 42	Weight Change %	ITS MN/m² 4.38	IEB % 625	IM_{100} MN/m² 0.39	IM_{300} MN/m² 1.08	H BS° 42	Weight Change %
ITS	% IEB	% IM_{100}	% IM_{300}			% ITS	% IEB	% IM_{100}	% IM_{300}		
29	74	42	61	40	+ 8.9	25	19	204	-	33	+ 7.6
Too weak to test						Very soft; too weak to test					
ITS .5	IEB 277	IM_{100} 5.27	IM_{300} -	H 86	Weight Change %	ITS 7.5	IEB 277	IM_{100} 5.27	IM_{300} -	H 86	Weight Change %
ITS	% IEB	% IM_{100}	% IM_{300}			% ITS	% IEB	% IM_{100}	% IM_{300}		
58	44	80	-	83	+ 8.9	78	54	106	-	77	+ 5.1
53	27	-	-	83	+ 9.7	72	30	-	-	79	+ 8.4
39	19	-	-	85	+ 11.9	83	26	-	-	76	+ 7.3
38	20	-	-	73	+ 24.4	90	14	-	-	76	+ 8.8
38	18	-	-	76	+ 12.9	86	4	-	-	74	+ 14.4
ITS 7.6	IEB 250	IM_{100} 12.1		H 87	Weight Change %	ITS 17.6	IEB 150	IM_{100} 12.1		H 87	Weight Change %
IBS	% IEB	% IM_{100}				% ITS	% IEB	% IM_{100}			
122	116	130		87	+ 14.5	109	120	212		86	+ 8.2
110	108	113		78	+ 15.2	114	118	120		92	+ 5.3
108	93	119		84	+ 15.6	124	123	144		88	+ 6.7
107	88	120		82	+ 17.3	125	117	136		90	+ 4.5
119	109	130		83	+ 15.9	111	103	134		90	+ 4.1

TABLE 3

EFFECT OF EXPLOSIVE TNT AND PROPELLANT NQ (

Temperature of Test $60^{\circ} \pm 0.5^{\circ}C$

Material	Exposure, months	Control					TNT		
		IYS MN/m^2 No yield	ITS MN/m^2 40.3	IEY mm No yield	IEB mm 4	Weight Change %	IYS MN/m^2 No yield	ITS MN/m^2 40.3	IEY mm No yie
		% IYS	% ITS	% IEY	% IEB		% IYS	% ITS	% IEY
GP Polystyrene	1	-	114	-	100	< 0.01	-	116	-
	3	-	1	-	-	- 0.02	-	120	-
	6	-	104	-	106	< 0.01	-	121	-
	9	-	113	-	112	< 0.01	-	116	-
	12	-	108	-	126	< 0.01	-	118	-
		IYS 55.2	ITS 69.6	IEY 12	IEB 122	Weight Change %	IYS 55.2	ITS 69.6	IEY 12
		% IYS	% ITS	% IEY	% IEB		% IYS	% ITS	% IEY
Nylon 6	1	119	59	69	28	- 0.7	89	110	126
	3	136	62	87	15	- 1.1	128	58	83
	6	135	70	61	15	- 0.9	151	66	50
	9	135	72	60	15	- 1.2	146	67	67
	12	151	68	82	15	- 0.5	139	65	89
		IYS 60.6	ITS 64.0	IEY 13	IEB 100	Weight Change %	IYS 60.6	ITS 64.0	IEY 13
		% IYS	% ITS	% IEY	% IEB		% IYS	% ITS	% IEY
Nylon 66	1	112	80	90	56	- 0.7	92	104	136
	3	Not measured				+ 1.3	118	85	110
	6	117	94	80	15	- 0.5	132	93	42
	9	121	96	90	28	- 0.8	128	88	86
	12	132	98	81	21	- 1.2	124	91	101

TABLE 3

SIVE TNT AND PROPELLANT NQ ON PLASTICS

perature of Test $60^{o}\pm0.5^{o}C$

	TNT					NQ				
ht ge	IYS MN/m² No yield	ITS MN/m² 40.3	IEY mm No yield	IEB mm 4	Weight Change %	IYS MN/m² No yield	ITS MN/m² 40.3	IEY mm No yield	IEB mm 4	Weight Change %
	% IYS	% ITS	% IEY	% IEB		% IYB	% ITS	% IEY	% IEB	
01	-	116	-	144		-	70	-	138	+ 0.05
02	-	120	-	156		-	121	-	10	+ 0.06
01	-	121	-	100		-	110	-	112	+ 0.10
01	-	116	-	106		-	118	-	194	+ 0.1[illegible]
1	-	118	-	132		-	114	-	157	+ 0.13
nt ge	IYS 55.2	ITS 69.6	IEY 12	IEB 122	Weight Change %	IYS 55.2	ITS 69.6	IEY 12	IEB 122	Weight Change %
	% IYS	% ITS	% IEY	% IEB		% IYB	% ITS	% IEY	% IEB	
	89	110	126	216	+ 1.6	-	72	-	66	+ 0.2
	128	58	83	24	- 0.2	116	57	67	29	+ 0.6
	151	66	50	12	- 0.4	132	62	82	11	+ 0.5
	146	67	67	15	+ 0.1	83	32	144	20	+ 0.9
	139	65	89	30	+ 0.1	118	43	105	16	+ 0.3
nt e	IYS 60.6	ITS 64.0	IEY 13	IEB 100	Weight Change %	IYS 60.6	ITS 64.0	IEY 13	IEB 100	Weight Change %
	% IYS	% ITS	% IEY	% IEB		% IYB	% ITS	% IEY	% IEB	
	92	104	136	166	+ 1.1	-	92	-	15	+ 0.3
	118	85	110	34	- 0.6	-	92	-	31	+ 0.2
	132	93	42	18	- 0.4	-	91	66	16	- 2.8
	128	88	86	18	- 0.4	-	82	-	37	- 1.4
	124	91	101	29	- 0.5	-	100	-	23	- 0.02

TABLE 4

EFFECT OF EXPLOSIVE TNT AND PROPELLANT

Temperature of Test 60°±0.5°

Material	Exposure, months	Control						
		IYS MN/m² 25.5	ITS MN/m² 20.0	IEY mm 9	IEB mm 260	Weight Change %	IYS MN/m² 25.5	ITS MN/m² 20.0
		% IYS	% ITS	% IEY	% IEB		% IYS	% ITS
High Density Polyethylene PEHD	1	101	106	153	130	+ 0.01	103	104
	3	102	92	139	63	+ 0.03	99	95
	6	114	101	92	67	+ 0.03	105	101
	9	102	98	101	69	+ 0.03	104	102
	12	102	101	102	75	+ 0.04	103	119
		IYS 11.3	ITS 11.9	IEY 36	IEB 47	Weight Change %	IYS 11.3	ITS 11.9
		% IYS	% ITS	% IEY	% IEB		% IYS	% ITS
Low Density Polyethylene PELD	1	-	104	-	106	< 0.01	-	106
	3	-	92	-	106	- 0.02	-	98
	6	-	120	-	116	- 0.02	-	104
	9	-	105	-	128	- 0.02	-	113
	12	-	106	-	147	- 0.05	-	116
		IYS -	ITS 76.5	IEY -	IEB 7	Weight Change %	IYS -	ITS 76.5
		% IYS	% ITS	% IEY	% IEB		% IYS	% ITS
Polymethyl-methacrylate	1	-	91	-	79	- 0.16	-	71
	3	-	92	-	118	- 0.33	Too encru	
	6	-	107	-	82	- 0.01		
	9	-	101	-	111	- 0.03		
	12	-	94	-	107	- 0.30		

TABLE 4

T AND PROPELLANT NQ ON PLASTICS

e of Test $60^{o} \pm 0.5^{o}C$

TNT					NQ				
YS /m² .5	ITS MN/m² 20.0	IEY mm 9	IEB mm 260	Weight Change %	IYS MN/m² 25.5	ITS MN/m² 20.0	IEY mm 9	IEB mm 260	Weight Change %
IYS	% ITS	% IEY	% IEB		% IYS	% ITS	% IEY	% IEB	
3	104	147	147	+ 0.8	101	104	139	74	+ 0.1
99	95	142	79	+ 0.7	104	95	97	62	+ 0.2
05	101	92	32	+ 0.9	105	101	114	100	+ 0.2
04	102	97	81	+ 0.7	102	97	128	114	+ 0.1
03	119	114	119	+ 0.5	101	102	175	171	+ 0.1
YS .3	ITS 11.9	IEY 36	IEB 47	Weight Change %	IYS 11.3	ITS 11.9	IEY 36	IEB 47	Weight Change %
IYS	% ITS	% IEY	% IEB		% IYS	% ITS	% IEY	% IEY	
-	106	-	147	+ 0.5	-	99	-	107	+ 2.3
-	98	-	106	+ 0.8	-	104	-	91	+ 3.0
-	104	-	93	+ 0.9	-	106	-	131	+ 3.5
-	113	-	183	+ 0.6	-	111	-	146	+ 2.4
-	116	-	150	+ 0.8	-	101	-	176	+ 0.8
YS -	ITS 76.5	IEY -	IEB 7	Weight Change %	IYS -	ITS 76.5	IEY -	IEB 7	Weight Change %
IYS	% ITS	% IEY	% IEB		% IYS	% ITS	% IEY	% IEB	
-	71	-	118	+ 12.8	Too encrusted to test				
Too encrusted to test					Too encrusted to test				

TABLE 5

VISUAL EXAMINATION OF PLASTI

Exposure time 12 months
Test temperature 60°C

Material	Control	TNT
PLASTICS		
High density polyethylene	No change	Very slight yellowi
Low density polyethylene	Slight yellowing	Very slight yellowi
Nylon 6	Dark brown colouration	Dark brown colourat
Nylon 66	Tinge of brown	Dark brown colourat
Polystyrene	No change	No change - still
Polymethylmethacrylate	No change	Dark brown - encru
RUBBERS		
Chlorobutyl rubber	Black - no change	Light brown dust a surface - no othe
Natural rubber	Black - no change	Light brown dust a surface - still f
Polybutadiene rubber	Black - no change	Still fairly flexi colouration on fl
Thermoelastic rubber A	White changing to yellow	Test discontinued
Thermoelastic rubber B	Black - no change	Light to dark brow still flexible
Plasticised PVC	Decrease in transparency - almost translucent	Dark brown covered brown powder - no

TABLE 5

MINATION OF PLASTICS

re time 12 months
emperature 60°C

TNT	NQ
ery slight yellowing	No apparent change
ery slight yellowing	No apparent change
ark brown colouration	Orange colouration
ark brown colouration	Orange tinge
o change - still transparent	No change - still transparent
ark brown - encrusted with TNT	Light brown - encrusted with propellant
ight brown dust adhering to surface - no other visible change	No visible change
ight brown dust adhering to surface - still flexible	Very hard and brittle
Still fairly flexible - brown colouration on flexing	Very hard and brittle
Test discontinued after 1 month's exposure as material was too weak to test	
Light to dark brown in colour - still flexible	Light to dark brown in colour - breaks on bending - fairly soft
Dark brown covered with light brown powder - not transparent	Light brown colouration - still fairly transparent

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